practicable to the point *a*. It was set at one side in the photograph to show more clearly.

I first employed a spiral spring on the axis *d* to hold *a* in contact with *F'*. The pressure of contact is not constant with different angular positions of the lever, and it is not easy to adjust such a spring minutely. I also tried a slightly unbalanced lever with the axis *d* tilted a little, in the proper way, to make *a* bear slightly against F'. This hardly admits of easy variations and nice adjustments. I considered, but rejected, the plan of maintaining *a* and *F'* in slight contact by mutual magnetic attraction. The contact, once broken, would not be automatically restored, which is a necessity in the process adopted for making time ticks.

The aluminum wire stylus, with its wax counterpoise, is clearly shown at *P* and *e* in the picture; the bevel on the edge of the cylinder is very imperfectly shown, however.

The ratio of the lengths of the two arms of the lever is at present set at 15 on this instrument. It is sensibly invariable, despite any adjustments which may be made of either *F* or *F'*.

Vibrator and time ticker.—This attachment is shown at *M* and is made over from the magnets of an ordinary small electric call bell. The magnets are rewound to a resistance of from 12 to 15 ohms. The bell and striker are dispensed with. The whole device is mounted on a stud that is simply fitted closely into a hole drilled into the yoke piece *G*. The two terminals of the coils are brought out directly to two binding posts. A third post is put in connection with one terminal through the vibrator. A single dry cell (voltage 1.4) is put on this circuit through the vibrator and causes the armature to vibrate with a low musical hum. A little lever, split so as to embrace the free portion of the contact spring on the armature, serves to alter the period of vibration somewhat.

It seems that very feeble action of the vibrator is able to set up microscopic tremors in the massive yoke piece, *G*, sufficient to keep the whole lower arm, *L*, in sustained movement, so that friction is greatly diminished and other desirable effects produced, as has already been explained.

In order to mark time it is necessary, or at least preferable, to stop the vibration of the armature for a second or two, then to cause the armature to strike a sharp blow by sending, for a fraction of a second, a current of proper strength directly through the magnet. On the instruments at the Weather Bureau the time is marked as follows: At the 30th second of each minute the standard time-keeping clock electrically releases momentarily the train of a secondary clock in the seismograph room. A slight movement ensues and cuts off the current to each vibrator. After exactly two seconds the secondary clock is again released momentarily and this time a strong current is sent momentarily through all the magnets joined in series, thereby causing the recording levers to simultaneously produce time marks. As the cycle of actions is completed on the separate instruments the strong current is cut out and the vibration again started. The apparatus seems more or less complicated in the description, but in reality it is relatively simple enough.

Smoking flame.—In smoking the record sheets the recording cylinder is mounted on the iron support furnished by the manufacturer. Over this is an ample iron hood connected directly with a chimney flue to carry off the excess smoke. The best form of lamp I have thus far tried is made with a flat lamp wick about 8 inches long by 1½ inches wide. A piece of tin a little longer than the wick and not quite so wide is bent longitudinally through the middle into a U-formed trough. The ends are closed by pinching together, or otherwise, and the whole is secured to a plate or other device to make the open edge stand up. The wick is folded longitudinally through the middle and inserted in the trough with the free edges projecting slightly and equally above. Kerosene or other oil is applied to the wick from an ordinary machinist's so-called "squirt can". In order to lessen the tendency of the flame to flutter and burn unevenly, I set up beside it, and about one-half inch or less distant, a flat plate of stiff sheet iron. This rises beside the flame to within a half inch or less of the recording drum. The ascent of heated air across this plate produces a more even flame than without the plate, which, moreover, I think tends to chill the flame and increase the volume of soot.

Paper and varnish for records.—The writer has found serious objections to the glazed paper commonly furnished and employed for record sheets, because it is too opaque to readily give photographic prints of records. It tears easily and the glazed coating is greatly affected by moisture, often causing the paper to curl up in the most unmanageable fashion. Finally, the soot coating very easily flakes off the glazed surface whenever a record is handled much, often defacing it in the most serious manner. A thin, smooth bond paper is vastly superior in point of durability, transparency, etc., but the lines are not quite so clearly visible by reflected light, as in the case of records on glazed paper. The sheets, however, remain flat and are much easier to file away.

The writer uses a celluloid varnish made as follows:

Thirty grams of transparent sheet celluloid is cut into narrow strips, which are then sharply bent at many points and thus crumpled up. These are placed in a large bottle (not less than two liters); 300 cubic centimeters of acetone is then added. After some hours with occasional shaking, a thick, viscous solution is formed. From 1500 to 1800 cubic centimeters of amyl acetate is then added and thoroughly mixed. A small portion of this is poured into a shallow tray, the top edges of which are ground true and flat in order that the tray may be closed practically air-tight by a small plate-glass cover. Such a tray, I find, prevents any appreciable waste of varnish and loss from evaporation. Sheets are varnished only on the smoked surface by passing it in contact with the liquid in the tray, while the sheet is held by the hand at each end so as to form a deep J-formed loop. The sheet is drained for a moment over the tray and dried while stretched horizontally between hooks, with the face downward to keep off dust.

The foregoing details relate to improvements that may, perhaps, be adapted to almost any seismograph with mechanical registration. I desire, in a second section of this paper, to discuss in a general way the dynamic characteristics of the more important seismographs now employed, with a view to indicating or contrasting their merits and defects.

WEATHER BUREAU MEN AS EDUCATORS.

Mr. George Reeder, Columbia, Mo., under date of May 17, 1906, referring to his regular course in the University of Missouri, states that the course included twenty lectures, and, as briefly described in the University catalogue, embraced the following subjects: (1) The earth's atmosphere—its composition, temperature, pressure, and circulation—dew, frost, clouds, rainfall, cyclones, thunderstorms, and tornadoes. (2) Weather and climate. Instruction under this second head included, among other topics, a discussion of the distribution of temperature and precipitation, the influence of winds upon climate, climate and weather, climate and health, comparison of climatic conditions at well-known health resorts of the world, weather records and health statistics, weather forecasting.

Charts, blackboard diagrams, photographs, and lantern slides were used to demonstrate the lectures; observations, written exercises, and laboratory work were required. The class consisted of nine students—eight medical and one agricultural. (Medical students are now required to take the course.) Each member of the class displayed great interest in the entire course, and the final examination was sustained in a very creditable manner.

Other work along the aforementioned lines during the first and second semesters was as follows:

Five informal talks on meteorology, instruments, etc., to mixed classes of University students that visited the office from time to time.

One lecture, on "Instruments and Methods used in Determining Climatic Conditions and Changes", to a body of visiting State teachers.

One lecture, on "Applied Meteorology", (illustrated) to the society of senior and junior engineers, University of Missouri.

One lecture, on "Practical Weather Forecasting", to the class in physics, Columbia High School.

One lecture, on "Applied Meteorology", (illustrated) before the "Scientific Association of the University of Missouri".

Mr. W. A. Shaw, Northfield, Vt., under date of April 16, 1906, reports that he has just completed a course of instruction in meteorology given to the senior class in Norwich University. This course covers a period of two hours per week during the winter term of twelve weeks. Waldo's Elementary Meteorology is used as a text-book for the foundation of the course, which is much amplified by reference to other standard works, maps, charts and publications of the Bureau. Special attention is given to the utility of meteorological reports, publications, and forecasts. He has given this course for the past ten years. It is a required study for all members of the senior class, who must pass a satisfactory examination in it as a prerequisite for graduation.

The college has recently purchased a Bausch & Lomb projection and photomicrographic apparatus of high grade which has been placed at the disposal of the observer so far as it can be utilized in his work. It is planned to use this equipment in work on snow crystals, clouds, lightning, and in making lantern slides of maps and charts to illustrate lectures on meteorology.

Mr. Shaw has been informed by President Spooner that in recognition of his work he has been made a member of the faculty, with the title of Professor of Meteorology.

Mr. A. H. Thiessen, Raleigh, N. C., under date of April 11, 1906, reports that he has just finished a course of lectures on meteorology and its applications, delivered to seniors in agriculture at the State College of Agriculture and Mechanic Arts. The class numbered about ten students.

Mr. M. R. Sanford, Syracuse, N. Y., under date of May 31, 1906, reports that the course in meteorology at Syracuse University, instead of being confined to the second semester, will be extended so as to continue throughout an entire college year, and in addition to this occasional lectures will be given on the general work of the Weather Bureau.

The following lectures and addresses by Weather Bureau men are reported:

Mr. H. F. Alciatore, May 23, 1906, a public address in the auditorium of the Little Rock, Ark., High School; also May 29, 1906, before the University of Arkansas, Fayetteville, on "The Work of the Weather Bureau", with lantern slide illustrations.

Mr. E. H. Bowie, May 11, 1906, before the St. Louis, Mo., Railway Club, on "The Weather Bureau and its Relation to Transportation", with lantern slide illustrations. (The paper and many of the illustrations are reproduced in the Official Proceedings of the Club, Vol. XI, No. 1.)

Mr. Ford A. Carpenter, May 28, 1906, before the senior class of the San Diego, Cal., State Normal School, on "Meteorology."

Mr. M. R. Sanford, May 3, 1906, before the students and members of the faculty of Syracuse University, a lecture illustrated with lantern slides; also May 12, 1906, an address to the Principal's Council of Onondaga County, on "Meteorology in the Schools".

Mr. J. M. Sherier, May 3, 1906, before the Contemporary Club, of Davenport, Iowa, on "Weather Forecasts and Warnings", with lantern slide illustrations.

Mr. F. J. Walz, May 19, 1906, before the Louisville, Ky., Educational Association, on "The Weather", illustrated with lantern slides.

Classes from universities, schools, and academies have visited Weather Bureau offices, to study the instruments and equipment and receive informal instruction, as reported from the following offices:

Buffalo, N. Y., May 1, 1906, a physical geography class from the Central High School; May 8, a class from Buffalo Mount Mercy Academy; May 15, a physical geography class from the Lafayette High School.

Detroit, Mich., May 9 and 11, 1906, classes of High School students; May 26, Prof. C. A. Davis and his class in meteorology, from the University of Michigan, Ann Arbor.

Hannibal, Mo., April 12, 1906, a class from the South School.

Hartford, Conn., May 28, 1906, senior grade pupils of the Arsenal Grammar School.

Pensacola, Fla., May 28, 29, and 30, 1906, the physical geography class of the Pensacola High School, in three sections.

Santa Fe, N. Mex., May 1, 1906, the eight grade pupils of the Allison Mission School.

Springfield, Mo., May 24, 1906, the physical geography class of the Springfield Normal School.

Syracuse, N. Y., May 4, 1906, a class from the Warners, N. Y., High School.

EDUCATIONAL NOTES.

We are informed that the question of offering meteorology as a course of instruction to the students of the University of Arkansas will be taken up as soon as the legislature makes the necessary appropriations, as the university authorities are satisfied that the study of meteorology and climatology will prove of practical benefit.

For admission to Harvard College as a candidate for the degree of S. B., under the new system which goes into effect this year, (as for some years hitherto for admission to the college as a candidate for the degree of A. B., or to the Lawrence Scientific School) a candidate may offer meteorology as one of the elective advanced studies. The student must have pursued a course of observational study, and must take both a written and a laboratory examination; the latter may include the use of instruments, the discussion of observations, and the construction and interpretation of weather maps and climatic charts. A knowledge of elementary physics is required for taking this preparatory course in meteorology, and the university has issued a pamphlet entitled "An Outline of Requirements in Meteorology", to serve as a guide in pursuing the study for the examination. The examination, if passed, counts as one point of the total twenty-six points required for entrance into Harvard College or the Scientific School. The work of preparation in this subject is substantially equivalent to that in the elementary course in meteorology (Geology B) offered to students of the university.

The method of teaching meteorology by laboratory experimentation, by personal drawings, observations, and computations, as distinguished from the mere committing to memory the statements of a text-book, is well illustrated by pages 10–25 of a little pamphlet entitled "Topics in Elementary Geography," by C. P. Sinnot, of the State Normal School, Bridgewater, Mass. This consists of questions or problems